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What is claimed is:

1. A gas concentration detecting apparatus comprising:

a gas concentration sensor provided with

5 a first cell for discharging oxygen contained in a gas to be detected introduced in a chamber from the chamber and for charging oxygen into the chamber,

a second cell for detecting a concentration of a specific gas component of the gas that has passed along the first cell, and

10 a third cell for detecting a concentration of residual oxygen in the gas that remains after the oxygen has been discharged through the first cell; and

a gas concentration calculator configured to take in a current signal acquired from the second cell measured with a voltage applied to
15 at least the second cell and calculate the concentration of the specific gas component based on the current signal acquired from the second cell, the gas concentration calculator including a plurality of concentration calculating means of which concentration detecting ranges are different in a scale from each other and the concentration of
20 the specific gas component being calculated every concentration calculating means.

2. The gas concentration detecting apparatus according to claim 1, wherein the gas concentration calculator is provided with a
25 plurality of controllers to which the concentrations of the specific gas component calculated by the concentration calculating means are supplied, respectively.

3. The gas concentration detecting apparatus according to
30 claim 2, wherein the gas concentration sensor is arranged to an exhaust duct of an engine mounted in a vehicle so that an exhaust gas flowing through the exhaust duct is treated as the gas to be detected and a

concentration of a specific gas component of the exhaust gas is detected,

wherein, of the plurality of concentration calculating means, concentration calculating means of which concentration detecting range is smaller is assigned to calculation of the concentration of the specific gas component for controlling the engine and further concentration calculating means of which concentration detecting range is larger is assigned to calculation of the concentration of the specific gas component for diagnosing a fault of the engine.

4. The gas concentration detecting apparatus according to claim 3, wherein the gas concentration sensor is further provided with a circuit configured to measure a current signal acquired from the third cell measured with a voltage applied to the third cell and

the gas concentration calculator is further provided with a differential amplifying circuit to receive both the current signals coming from the second and third cells and differentially amplify both the current signals and a A/D converter to digitize a result signal outputted from the differential amplifying circuit, whereby the digitized signal is provided to the computation of the concentration of the specific gas component.

5. The gas concentration detecting apparatus according to claim 3, wherein the gas concentration sensor is further provided with a circuit configured to measure a current signal acquired from the third cell measured with a voltage applied to the third cell and

the gas concentration calculator is further provided with a differential amplifying circuit to receive both the current signals coming from the second and third cells and differentially amplify both the current signals and a A/D converter to digitize a result signal outputted from the differential amplifying circuit, both of the differential amplifying circuit and the A/D converter belonging to, of the plurality of

concentration calculating means, concentration calculating means of which concentration detecting range is small, whereby the digitized signal is provided to the computation of the concentration of the specific gas component.

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6. The gas concentration detecting apparatus according to claim 1, wherein the gas concentration sensor is arranged to an exhaust duct of an engine mounted in a vehicle so that an exhaust gas flowing through the exhaust duct is treated as the gas to be detected and a
10 concentration of a specific gas component of the exhaust gas is detected,

wherein, of the plurality of concentration calculating means, concentration calculating means of which concentration detecting range is smaller is assigned to calculation of the concentration of the specific
15 gas component for controlling the engine and further concentration calculating means of which concentration detecting range is larger is assigned to calculation of the concentration of the specific gas component for diagnosing a fault of the engine.

20 7. The gas concentration detecting apparatus according to claim 1, wherein the gas concentration sensor is further provided with a circuit configured to measure a current signal acquired from the third cell measured with a voltage applied to the third cell and

the gas concentration calculator is further provided with a
25 differential amplifying circuit to receive both the current signals coming from the second and third cells and differentially amplify both the current signals and a A/D converter to digitize a result signal outputted from the differential amplifying circuit, whereby the digitized signal is provided to the computation of the concentration of the specific gas
30 component.

8. The gas concentration detecting apparatus according to

claim 1, wherein the gas concentration sensor is further provided with a circuit configured to measure a current signal acquired from the third cell measured with a voltage applied to the third cell and

the gas concentration calculator is further provided with a differential amplifying circuit to receive both the current signals coming from the second and third cells and differentially amplify both the current signals and a A/D converter to digitize a result signal outputted from the differential amplifying circuit, both of the differential amplifying circuit and the A/D converter belonging to, of the plurality of concentration calculating means, concentration calculating means of which concentration detecting range is small, whereby the digitized signal is provided to the computation of the concentration of the specific gas component.

9. The gas concentration detecting apparatus according to claim 1, wherein the gas concentration sensor is arranged to an exhaust duct of an engine mounted in a vehicle so that an exhaust gas flowing through the exhaust duct is treated as the gas to be detected and a concentration of a specific gas component of the exhaust gas is detected,

wherein, of the plurality of concentration calculating means, concentration calculating means of which concentration detecting range is smaller is assigned to calculation of the concentration of the specific gas component for controlling the engine and further concentration calculating means of which concentration detecting range is larger is assigned to calculation of the concentration of the specific gas component for diagnosing a fault of the engine.

10. The gas concentration detecting apparatus according to claim 9, wherein the gas concentration sensor is further provided with a circuit configured to measure a current signal acquired from the third cell measured with a voltage applied to the third cell and

the gas concentration calculator is further provided with a differential amplifying circuit to receive both the current signals coming from the second and third cells and differentially amplify both the current signals and a A/D converter to digitize a result signal outputted from the differential amplifying circuit, whereby the digitized signal is provided to the computation of the concentration of the specific gas component.

11. The gas concentration detecting apparatus according to claim 9, wherein the gas concentration sensor is further provided with a circuit configured to measure a current signal acquired from the third cell measured with a voltage applied to the third cell and

the gas concentration calculator is further provided with a differential amplifying circuit to receive both the current signals coming from the second and third cells and differentially amplify both the current signals and a A/D converter to digitize a result signal outputted from the differential amplifying circuit, both of the differential amplifying circuit and the A/D converter belonging to, of the plurality of concentration calculating means, concentration calculating means of which concentration detecting range is small, whereby the digitized signal is provided to the computation of the concentration of the specific gas component.

12. The gas concentration detecting apparatus according to claim 1, wherein the gas concentration calculator is provided with means for correcting sensitivity in computing the concentration of the specific gas component depending on the current concentration of the specific gas component.

13. The gas concentration detecting apparatus according to claim 1, wherein the gas concentration calculator is provided with means for correcting an oxygen concentration dependency in computing

the concentration of the specific gas component depending on a current concentration of oxygen included in the gas to be detected.

14. The gas concentration detecting apparatus according to claim 1, wherein the gas concentration calculator is provided with a memory in which map data is stored, the map data being defined by employing as parameters both of the concentration of the specific gas component included in the gas to be detected and a concentration of oxygen included in gas to be detected, means for setting a sensitivity correction coefficient by using the map data depending on the current concentrations of the specific gas component and the oxygen, and means for correcting the concentration of the specific gas component with the use of the sensitivity correction coefficient.

15. A gas concentration detecting apparatus comprising:

a gas concentration sensor provided with

a first cell for discharging oxygen contained in a gas to be detected introduced in a chamber from the chamber and for charging oxygen into the chamber,

a second cell for detecting a concentration of a specific gas component a gas that has passed along the first cell, and

a third cell for detecting a concentration of residual oxygen in the gas that remains after the oxygen has been discharged through the first cell; and

a gas concentration calculator is provided with a circuit to take in a current signal acquired from the second cell measured with a voltage applied to the second cell and to take in a current signal acquired from the third cell measured with a voltage applied to the third cell, a differential amplifying circuit to receive both the current signals coming from the second and third cells and differentially amplify both the current signals and a A/D converter to digitize a result signal outputted from the differential amplifying circuit, whereby the digitized

signal is provided to the computation of the concentration of the specific gas component.

16. The gas concentration detecting apparatus according to
5 claim 15, wherein the gas concentration calculator is provided with means for correcting sensitivity in computing the concentration of the specific gas component depending on the current concentration of the specific gas component.

10 17. The gas concentration detecting apparatus according to claim 16, wherein the gas concentration calculator is provided with means for correcting an oxygen concentration dependency in computing the concentration of the specific gas component depending on a current concentration of oxygen included in the gas to be detected.

15 18. The gas concentration detecting apparatus according to claim 17, wherein the gas concentration calculator is provided with a memory in which map data is stored, the map data being defined by employing as parameters both of the concentration of the specific gas
20 component included in the gas to be detected and a concentration of oxygen included in gas to be detected, means for setting a sensitivity correction coefficient by using the map data depending on the current concentrations of the specific gas component and the oxygen, and means for correcting the concentration of the specific gas component
25 with the use of the sensitivity correction coefficient.

19. The gas concentration detecting apparatus according to claim 15, wherein the gas concentration calculator is provided with means for correcting an oxygen concentration dependency in computing
30 the concentration of the specific gas component depending on a current concentration of oxygen included in the gas to be detected.

20. The gas concentration detecting apparatus according to claim 15, wherein the gas concentration calculator is provided with a memory in which map data is stored, the map data being defined by employing as parameters both of the concentration of the specific gas component included in the gas to be detected and a concentration of oxygen included in gas to be detected, means for setting a sensitivity correction coefficient by using the map data depending on the current concentrations of the specific gas component and the oxygen, and means for correcting the concentration of the specific gas component with the use of the sensitivity correction coefficient.